

## Cree® XLamp® CX Family LEDs



### INTRODUCTION

This application note applies to ceramic XLamp® CX family LEDs, i.e., CXA/CXB LEDs other than the out-of-production CXA2011 LED, which have order codes in the following format:

CXxxxxx-xxxx-xxxxxxxxxx

This application note explains how XLamp CX family LEDs and assemblies containing these LEDs should be handled during manufacturing. Please read this entire document to understand how to properly handle XLamp CX family LEDs.

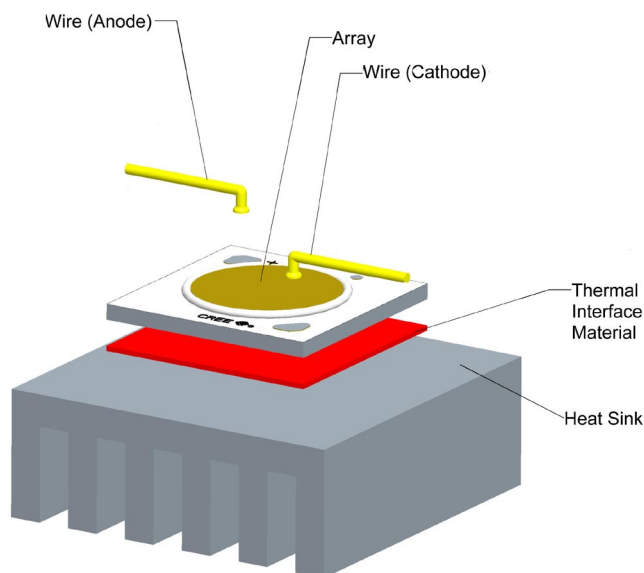
The [CX Family LED Design Guide](#) provides basic information on the requirements to use Cree XLamp CX family LEDs successfully in luminaire designs.

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## HANDLING XLAMP® CX FAMILY LEDS

In general, CX family LEDs are attached directly to a heat sink and discrete wires are used to deliver power to the LED, as illustrated below.



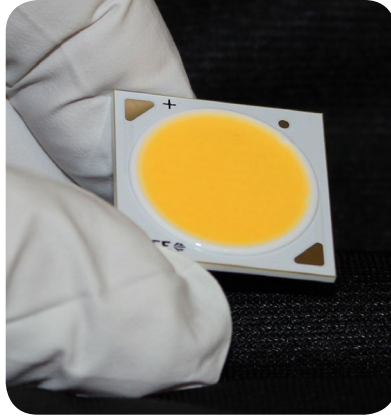
Cree recommends the following at all times when handling XLamp CX family LEDs or assemblies containing XLamp CX family LEDs:

- Avoid putting mechanical stress on the LED.
- Never touch the optical surface with fingers or sharp objects. The LED surface could be soiled or damaged, which could affect the optical performance of the LED
- Cree recommends always handling CX family LEDs with appropriate ESD grounding.
- Cree recommends handling CX family LEDs wearing clean, lint-free gloves.

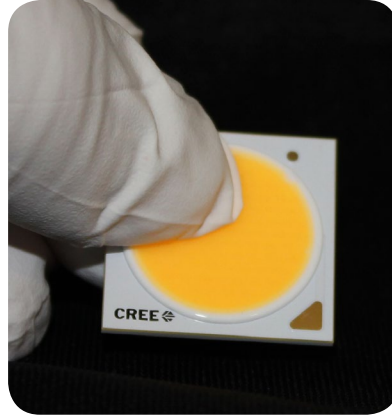
## Manual Handling

Do not touch the lens with fingers. Do not push on the lens.

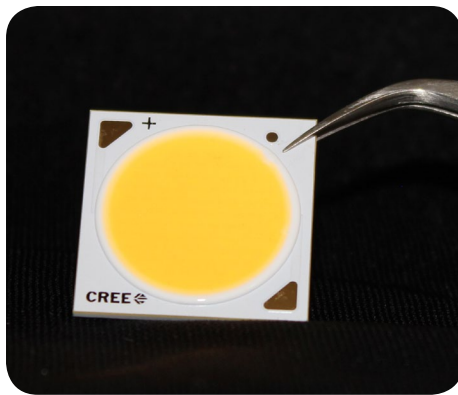
✓  
**CORRECT**



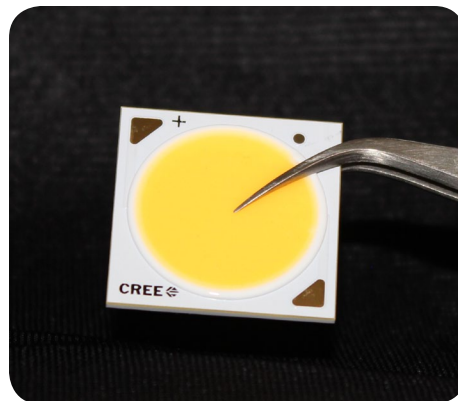
✗  
**WRONG**



✓  
**CORRECT**



✗  
**WRONG**



When using tweezers to handle XLamp CX family LEDs, do not touch the lens with the tweezers.

## HEAT SINK, LAYOUT, THERMAL INTERFACE

To insure effective thermal management for CX family LEDs, Cree recommends the CX family LED be attached to an appropriately sized heat sink, depending on drive current and intended operating environment. Refer to the CX family LED data sheets for the maximum case to ambient temperature thermal resistance that must be observed to ensure the CX family LED operates at or below its maximum rated case temperature (T<sub>c</sub>).

Attaching a CX family LED to a heat sink is most often accomplished by inserting a pad of thermal interface material (TIM), thermally conductive epoxy, or thermal grease between the CX family LED and heat sink and is strongly recommended. For best thermal results, the TIM thickness should be kept to a minimum while assuring there are no voids. Good thermal conductivity is an important ingredient in a successful LED-based lamp or luminaire and is ignored at one's peril. The following formula shows how the factors that influence thermal resistance (R<sub>th</sub>) are related.

$$R_{th} = \text{Thickness} / (\text{Conductivity} * \text{Area})$$

For CX family LEDs, a reflective TIM or other backing should be used; light output and efficiency may be slightly less if a non-reflective TIM is used. The thermal performance of the TIM should not be compromised in favor of high reflectivity. The penalty for lower thermal performance is higher than the penalty for lower reflectivity.

High thermal performance + high reflectivity = best  
High thermal performance + low reflectivity = better  
Low thermal performance + high reflectivity = bad  
Low thermal performance + low reflectivity = worst

Cree has used Arctic Silver® adhesive and Timtronics Silver Ice thermal grease in reference designs with good results. There are a number of TIMs available; some are listed in the [Thermal Management of Cree XLamp LEDs application note](#). There are a number of factors in the decision to use a particular TIM including, but not limited to, cost, availability, ease of use and manufacturing techniques, and recommending a specific TIM for any lighting application is out of the scope of this document.

Cree recommends securing CX family LEDs to a heat sink using the structure of the lamp or luminaire, thermally conductive epoxy, which is discussed previously in this section, or an LED holder, which is discussed in the LED Connectors section. Regardless of attachment method, Cree recommends following the manufacturer's directions for application to achieve maximum thermal performance. Use caution when securing CX family LEDs over relatively thick TIMs, such as thermal pads or thermal tape, to avoid catastrophic mechanical damage to the LED.

CX family LEDs are not designed to be attached by metal connectors, e.g., screws, nails, brads, bolts, pins, hooks or rivets, that directly contact the LED package. The use of such metal connectors can cause catastrophic mechanical damage to the LED.

### CASE TEMPERATURE MEASUREMENT POINT

XLamp CX family LED case temperature can be measured at the designated case temperature measurement point, adjacent to the anode or plus (+) solder pad. This measurement point is shown in the pictures below. Cree recommends attaching the thermocouple with conductive epoxy.

CXA13xx  
CXB13xx



CXA15xx  
CXB15xx



CXA18xx  
CXB18xx



CXA25xx  
CXB25xx



CXA30xx  
CXB30xx

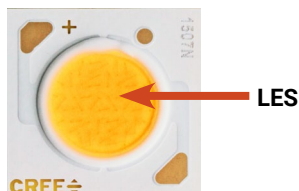


CXA3590  
CXB3590  
CXA2 Studio



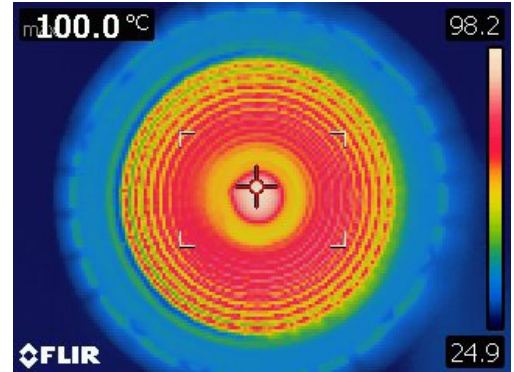
### LIGHT-EMITTING SURFACE TEMPERATURE MEASUREMENT

The light-emitting surface (LES) of XLamp CX family LEDs is defined as the central region of the LED, which contains the encapsulated chip array as shown below.



LES temperatures are measured using an infrared (IR) thermal imaging camera. IR cameras detect the infrared wavelength thermal emission from an object's surface, which is correlated to the surface temperature using the surface's thermal emissivity. CX family LES thermal emissivity is 0.98. Please consult the IR camera's operating instructions for proper measurement settings and guidelines. Factors that can affect the accuracy of IR thermal measurement include the distance to the object's surface, image focus and ambient conditions.

Making accurate LES temperature measurements requires the IR camera to have a direct line-of-sight view of the LES. Remove all lenses, diffusers and baffles that cover the LES before making a measurement. Measure LES temperatures when the LED has reached thermal equilibrium under steady-state operation. An example IR thermal image of a CX family LED in a luminaire is shown at the right. The LES temperature at the position of the crosshairs is reported in the upper left corner of the image.



## NOTES ON SOLDERING XLAMP® CX FAMILY LEDS

XLamp CX family LEDs are designed for electrical connection using wire-attach soldering or a connector. Cree recommends the use of a connector to help ensure proper clamping force is applied to the CX family LED and to help prevent damage that can occur during wire-attach soldering. See the [CX Family LED Design Guide](#) for a list of available connectors.

Cree makes the following recommendations to get the maximum benefit from wire-attach soldering:

- Do not pre-heat CX family LEDs before soldering.
- Use "no clean" lead-free solder.
- Use a temperature-controlled soldering iron having a minimum 60 W of power to help ensure the temperature of the tip remains stable during soldering.
- Use a solder tip with a width of 2.6 mm (0.1 in) or greater.
- Ensure that solder tip temperature measures and does not exceed 380 °C.
- Perform soldering (including pre-tinning) on a thermally non-conductive surface.
- Ensure a contact time with bond pads of 3 seconds or less.
- Return CX family LEDs to room temperature after each soldering step. It is imperative that this recommendation be followed. Cree recommends placing the CX family LED on a thermally conductive surface such as an aluminum block for at least 10 seconds to return the LED to room temperature.

The following example hand-soldering steps are based on the above recommendations.

1. Start from ambient temperature conditions.
2. Pre-tin the first bond pad on a thermally non-conductive surface, allowing no more than a 3-second maximum contact time.
3. Let the LED return to room temperature.
4. Pre-tin the second bond pad on a thermally non-conductive surface, allowing no more than a 3-second maximum contact time.
5. Let the LED return to room temperature.



6. Pre-tin the first wire.
7. Pre-tin the second wire.
8. Solder the first wire to the first bond pad, allowing no more than a 3-second maximum contact time.
9. Let the LED return to room temperature.
10. Solder the second wire to the second bond pad, allowing no more than a 3-second maximum contact time.
11. Let the LED return to room temperature before subsequent handling.

Use caution when soldering and handling CX family LEDs to avoid damaging the LEDs. Solder reworking should be kept to a minimum because of the potential for solder-pad lifting and damage to the LED from multiple applications of high heat from a soldering iron. Additionally, repetitive soldering introduces potential for solder flux to build up around the solder pads, which can cause long-term degradation if not properly removed.



### Solder Type

Cree strongly recommends using “no clean” solder with XLamp CX family LEDs so that cleaning the PCB after soldering is not required.

Cree recommends the following solder compositions: SnAgCu (tin/silver/copper) and SnAg (tin/silver).

### LOW TEMPERATURE OPERATION

The minimum operating temperature of these XLamp LED components is -40 °C. To maximize lifetime, Cree recommends avoiding applications where the lamps are cycled on and off more than 10,000 cycles at temperatures below 0 °C.

## NOTES ON CX FAMILY LED CONNECTORS

A number of firms have developed connectors to simplify the mechanical and electrical attachment of CX family LEDs. Companies that participate in the [Cree Solution Provider Program](#) (CSP) can supply connectors and connector information can be accessed from the Cree website.

The following firms are [interconnect solution providers](#). Clicking on a logo below displays that firm's interconnect products for CX family LEDs. Links are also provided below.<sup>1</sup>



If CX family LEDs are to be attached with wired leads, the horizontal and vertical pull force of the attached solder leads should not exceed 1000 g.

<sup>1</sup> BJB, Ideal Industries, Inc., Kangrong Fine Ceramic Co., Ltd., Molex, SMK Corporation, TE Connectivity LTD.



## CHEMICALS & CONFORMAL COATINGS

Below are representative lists of chemicals and materials to be used or avoided in LED manufacturing activities. For a complete and current list of recommended chemicals, conformal coatings and harmful chemicals consult Cree's [Chemical Compatibility application note](#). The video at [www.youtube.com/watch?v=t24bf9D\\_1SA](http://www.youtube.com/watch?v=t24bf9D_1SA) illustrates the process Cree has developed for testing the compatibility of chemicals and materials with LEDs. You should also consult your regional Cree Field Applications Engineer.

### Recommended Chemicals

In testing, Cree has found the following chemicals to be safe to use with XLamp CX family LEDs.

- Water
- Isopropyl alcohol (IPA)

### Chemicals Tested as Harmful

In general, subject to the specifics in Cree's [Chemical Compatibility application note](#), Cree has found certain chemicals to be harmful to XLamp CX family LEDs. Cree recommends not using these chemicals anywhere in an LED system containing XLamp CX family LEDs. The fumes from even small amounts of the chemicals may damage the LEDs.

- Chemicals that might outgas aromatic hydrocarbons (e.g., toluene, benzene, xylene)
- Methyl acetate or ethyl acetate (i.e., nail polish remover)
- Cyanoacrylates (i.e., "Superglue")
- Glycol ethers (including Radio Shack® Precision Electronics Cleaner - dipropylene glycol monomethyl ether)
- Formaldehyde or butadiene (including Ashland® PLIOBOND® adhesive)

### Hermetically Sealing Luminaires

For proper LED operation and to avoid potential lumen depreciation and/or color shift, LEDs of all types must operate in an environment that contains oxygen. Simply allowing the LEDs to ventilate to air is sufficient; no extraordinary measures are required. Hermetically sealing LEDs in an enclosed space is not recommended.

### HANDLING

Do not stack assemblies containing XLamp CX family LEDs so that anything rests on the LED lens. Force applied to the LED lens may result in the lens being damaged. Assemblies containing XLamp CX family LEDs should be stacked in a way to allow at least 2-cm clearance above the LED.

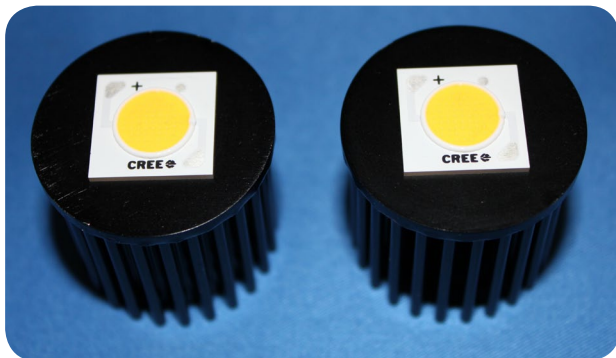
Do not use bubble wrap directly on top of the XLamp CX family LEDs. Force transferred through the bubble wrap can potentially damage the LED.

✓  
**CORRECT**



✗  
**WRONG**

✓  
**CORRECT**



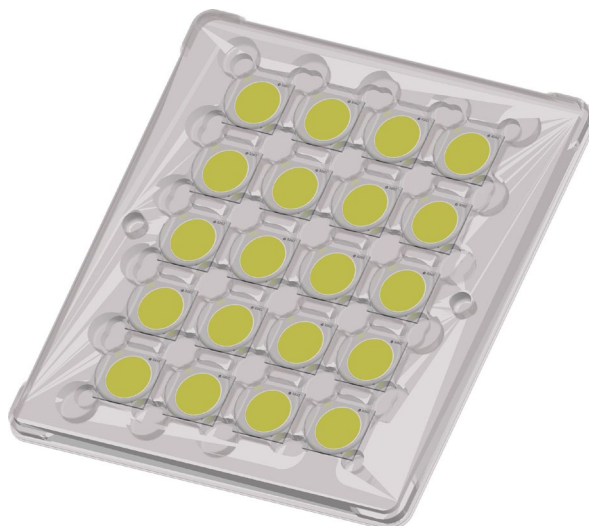
✗  
**WRONG**

### PACKAGING

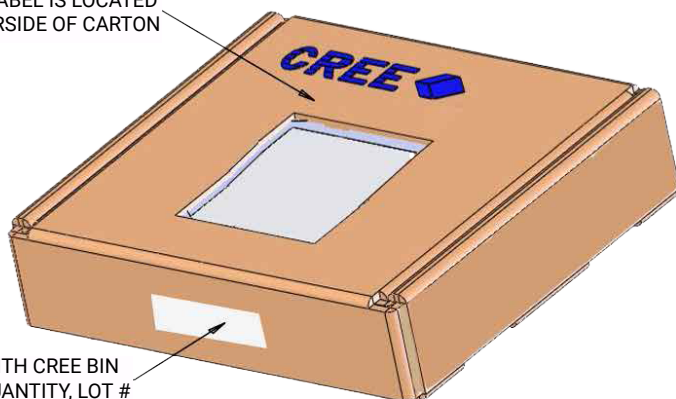
Beginning in April, 2013, Cree will be implementing a change from tube to tray packaging of CXA15xx, CXA2520 and CXA2530 LEDs. The change will occur in phases, and different CXA LEDs will be receiving the tray packaging at different times. After the change, customers will receive only the new tray packaging and stop receiving the tube packaging.

Cree is not repackaging inventory at our distributors that already exists in tube packaging. Customers purchasing through a distributor may not see the packaging change until the current tube inventory is depleted from distributor stock.

Cree CXA3590, CXB3590 and CXA2 Studio LEDs are packaged in trays of 10. Five trays are sealed in an anti-static bag and placed inside a carton, for a total of 50 LEDs per carton. Each carton contains 50 LEDs from the same performance bin. Other CX family LEDs are packaged in trays of 20. Five trays are sealed in an anti-static bag and placed inside a carton, for a total of 100 LEDs per carton. Each carton contains 100 LEDs from the same performance bin.

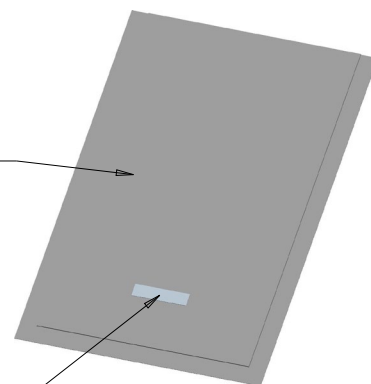


PATENT LABEL IS LOCATED  
ON UNDERSIDE OF CARTON



LABEL WITH CREE BIN  
CODE, QUANTITY, LOT #

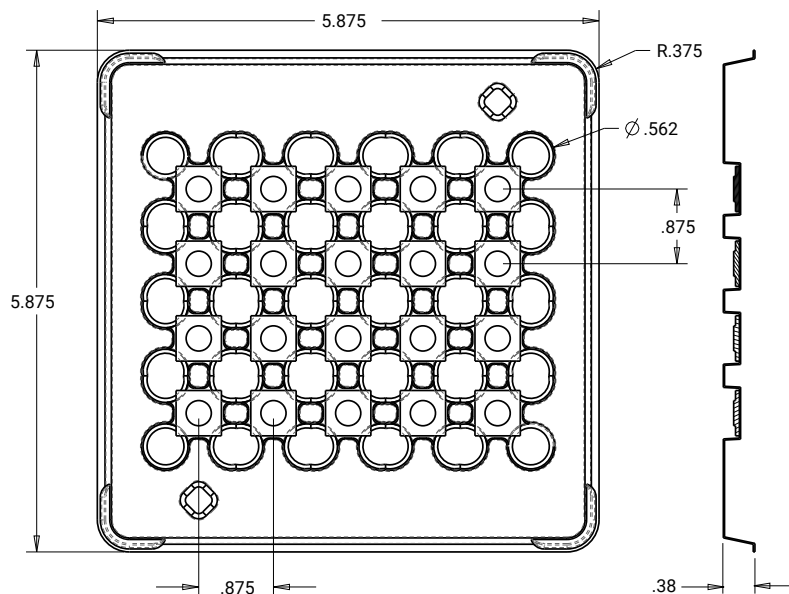
BAG



LABEL WITH CREE BIN  
CODE, QUANTITY, LOT#

### PACKAGING - CONTINUED

#### CXA13xx & CXB13xx



Dimensions are in inches.

Tolerances:

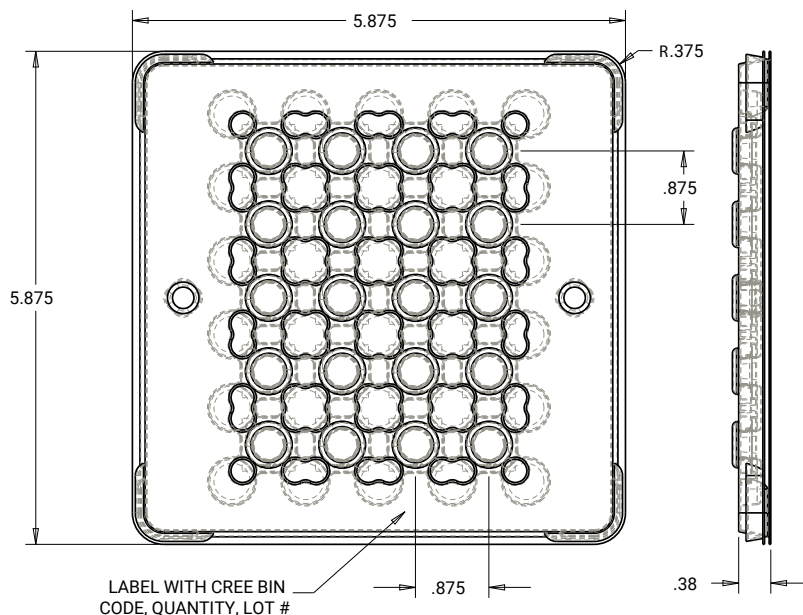
.x  $\pm .1$

.xx  $\pm .05$

.xxx  $\pm .005$

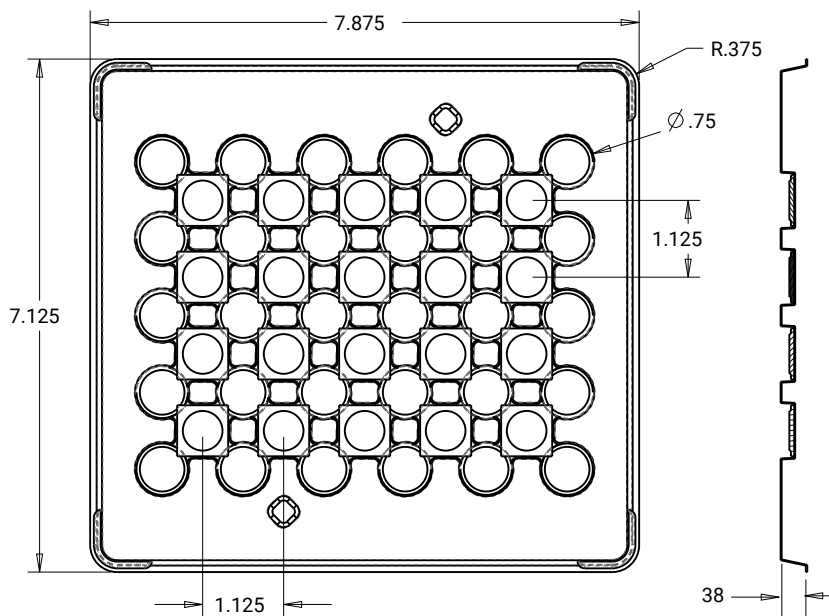
x°  $\pm 1^\circ$

#### CXA15xx & CXB15xx

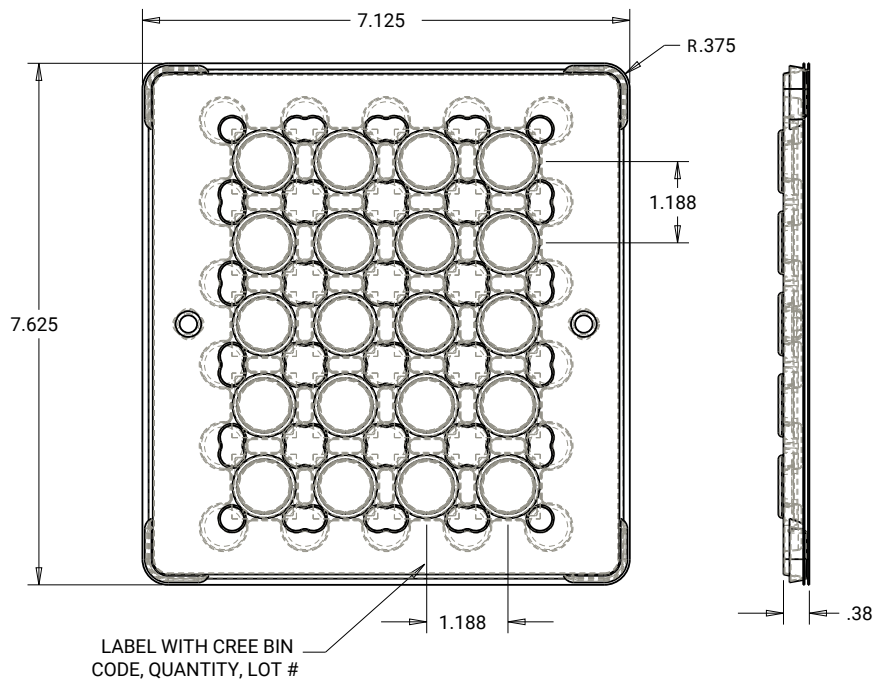


### PACKAGING - CONTINUED

#### CXA18xx & CXB18xx

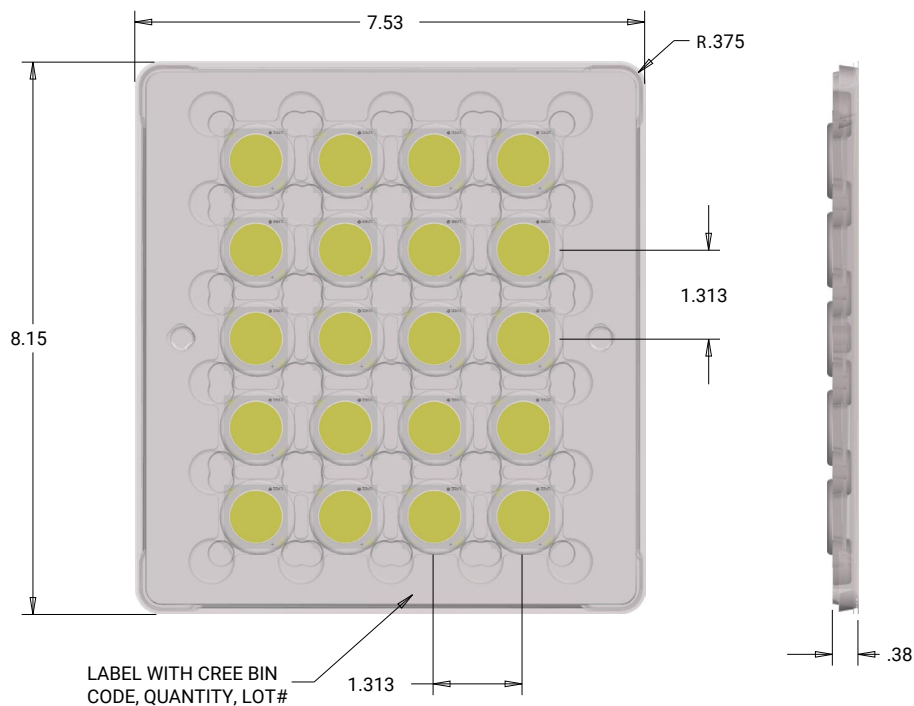


#### CXA25xx & CXB25xx



### PACKAGING - CONTINUED

#### CXA30xx & CXB30xx



#### CXA3590, CXB3590 & CXA2 Studio

